U.S. Agriculture is Vulnerable to Disease, Insect and Other Pest Threats. Ongoing Investment in Integrated Pest Management Safeguards the Agricultural Industry and Nation's Food Supply

Executive Summary

In 2020, the importance – and fragility – of American agriculture was made clear when COVID-related disruptions resulted in empty store shelves and food rationing for the first time in most Americans' lives.

The reality COVID drove home is that agriculture is *the* vital American industry, not just contributing $1 trillion to the U.S. economy and supporting more than 22 million jobs, but ensuring families have safe, affordable food.

But U.S. agriculture is threatened by invasive and native insects and diseases, which cost billions annually in control costs and harvest losses. Invasive pests are especially serious because they disrupt effective controls and can cause significant enviromental and economic damage.

Long-term control of pests is best achieved by integrated pest management, science-driven strategies that minimize health and environmental risks while providing cost-effective control. But because pest challenges change and evolve, integrated pest management must also constantly adapt. Ongoing investments in research and extension outreach are needed to safeguard America's agricultural industry and the nation's food supply.

The Regional Integrated Pest Management Centers play a criticl role in coordinating and funding these research and extension activities, protecting U.S. agriculture and our citizens.

The COVID pandemic illuminated many truths about the U.S. economy, but few more important than this: Agriculture is the vital American industry.

That point was driven home by empty store shelves, rationed quantities of staples like flour and eggs, and panic buying of food. In 2020, for the first time in most Americans' lives, there was no guarantee that the food they wanted to buy for their families would be available. Until COVID, food rationing hadn't happened in the United States since World War II. For the 92 percent of the U.S. population born after 1945 – 300 million of our 328 million citizens – COVID-related rationing was a new and disquieting experience.

It also made two realities very clear: American agriculture is absolutely vital, and American agriculture is uncomfortably fragile.

Fortunately, the immediate COVID-related market disruptions were short-lived as an innovative agricultural industry retrenched, redistributed and repackaged goods to get them to market. The longer-term impacts of the pandemic are still unknown and the threats to agricultural workers in fields, packing house and processing plants remains concerning.

And while COVID is caused by a human pathogen that came to U.S. shores from overseas, the U.S. agricultural industry faces constant threats from other diseases, insects and plants, including zoonotic pathogens that infect livestock and can mutate to become dangerous diseases in people. Before COVID, conventional wisdom held that the U.S. agricultural infrastructure was robust enough to manage even

An Issue Paper by the National Integrated Pest Management Coordinating Committee, representing U.S. Land Grant Universities, Regional and National Technical Committees and the U.S. Department of Agriculture's Regional Integrated Pest Management Centers

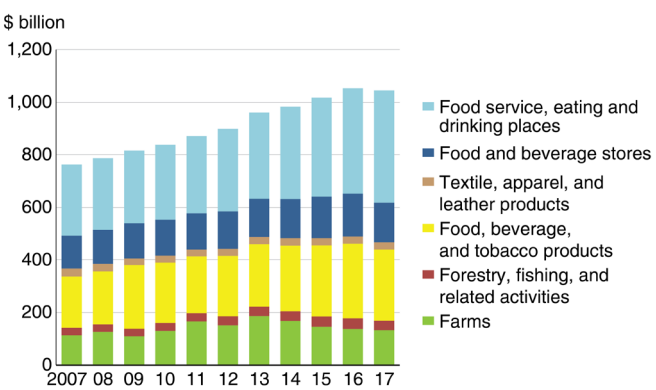
a widespread outbreak without severe disruptions to the food supply or consumer markets, but COVID challenged that conventional wisdom.

U.S. agriculture is vulnerable to domestic and invasive pests. A key way to reduce that vulnerability and increase resiliency in the system is to improve the ability of farmers, ranchers and land managers to manage pests safely and effectively using a science-based approach known as integrated pest management.

The Economic Importance of U.S. Agriculture

Agriculture, food and related industries contributed $1.053 trillion to U.S. gross domestic product in 2017, a 5.4-percent share. The output of America's farms contributed $132.8 billion of this sum—about one percent of GDP. However, the overall contribution of the agriculture sector to GDP is actually larger because sectors related to agriculture – forestry, fishing and related activities; food, beverages and tobacco products; textiles, apparel and leather products; food and beverage stores; and food service, eating and drinking places – rely on agricultural inputs

Value added to GDP by agriculture and related industries, 2007-17



Note: GDP refers to gross domestic product.
Source: USDA, Economic Research Service using data from U.S. Department of Commerce, Bureau of Economic Analysis, Value Added by Industry series.

in order to contribute added value to the economy.

In addition, 22 million full- and part-time jobs were related to the agricultural and food sectors in 2018 – 11 percent of total U.S. employment. Direct on-farm employment accounted for about 2.6 million of these jobs, or 1.3 percent of U.S. employment, while employment in agriculture- and food-related industries supported another 19.4 million jobs. Unlike jobs in schools or the retail sector, however, agricultural jobs are not evenly distributed across the country or even individual states. Instead, in many rural areas, agriculture is a primary industry and largest employer.[1]

But to most Americans, agriculture simply means food. Food costs account for nearly 13 percent of household expenditures, ranking third behind only housing and transportation. Agriculture means abundant and affordable plant and animal products; a healthy dinner on the table every night, or fresh snacks after school. The banking and insurance industries contribute more to the U.S. GDP annually, but families can't feed their children an insurance policy.

Pests Are a Constant Threat to Agriculture, Especially Invasive Species

The $132 billion in annual farm output noted above is produced in the face of constant pressure from insects, plant pathogens, weeds and crop-killing animals ranging from voles to birds to feral hogs.

These pests are endemic to agriculture, and American farmers spent $9 billion on crop-protecting chemicals – herbicides, insecticides and fungicides – in 2019 alone. (That figure does not include the costs of application, nor does is capture all the other ways growers manage pests.)[2]

Despite those billions spent, pests still cause significant crop losses in the United States and worldwide. On a global scale, insects and pathogens are causing wheat losses of 10 percent to 28 percent, rice losses of 25 percent to 41 percent, maize losses of 20 percent to 41 percent, potato losses of 8 percent to 21 percent, and soybean losses of 11 percent to 32 percent, according to a recent study in the journal Nature, Ecology & Evolution.[3]

Invasive pests pose unique challenges. When an invasive insect or disease is introduced, the economic impact and ecological disruptions can be extreme. The emerald ash borer was first detected in the United States in 2002, and to date has killed hundreds of millions of ash trees across 35 U.S. states.[4] Other recent invasive insect detections include spotted wing drosophila, a fruit fly causing extensive damage to cherries, berries and other soft-sided fruit, and the spotted lanterfly, which threatens grapes, hops and other crops and is spreading quickly from the Mid-Atlantic region.

Spotted laternfly. Photo: Pennsylvania Department of Agriculture

Invasive diseases pose an equally significant threat. Soybean rust, for example, is potentially one of the most significant diseases of soybean. It can spread quickly and cause defoliation of soybean plants. Under favorable conditions, the pathogen can cause yield losses greater than 50 percent. Soybean rust was first found in the continental United States in the South in 2004. Since then, the disease has spread northward each growing season and has now reached the upper Midwest.[5]

And while plant diseases spread more slowly than many diseases in humans, they do spread and in similar ways. HLB, a disease that sours citrus fruit, has spread West from Florida – where it has devastated the fresh citrus industry – across the southern half of the country to California. Like COVID, HLB spreads from trees that are infected but asymptomatic, making detection difficult.

The full cost of invasive species damage in the United States is unknown. A 2004 study estimated the cost at $120 billion annually,[6] and the U.S. Department of the Interior spends $100 million every year on invasive species prevention, early detection and rapid response, control and management, research, outreach, international cooperation and habitat restoration.[7]

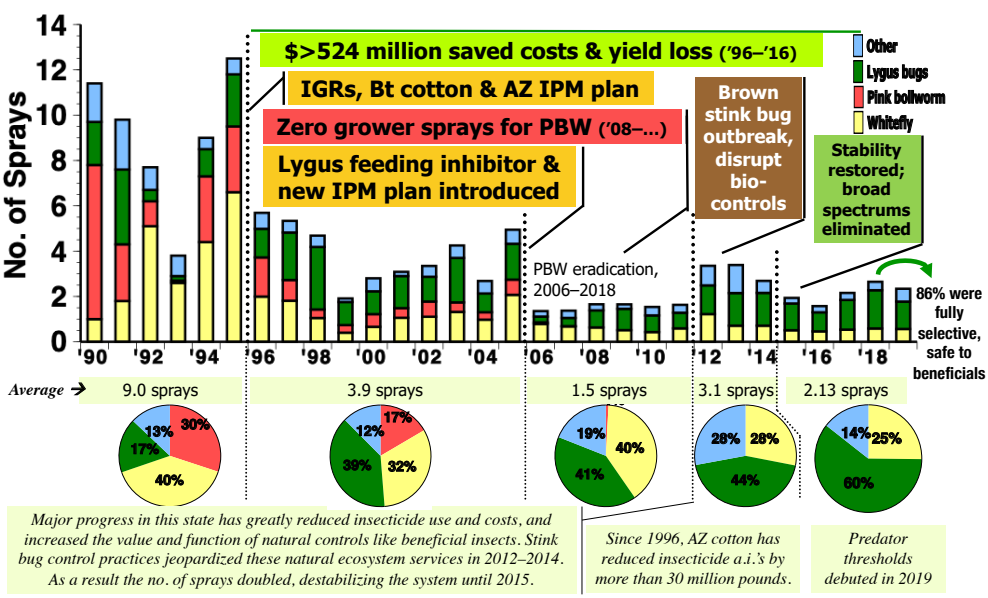
Loss of trade is another threat posed by invasive pests. Infectious diseases are also one of the few reasons authorized by the World Trade Organization for blocking imports of agricultural products, and restrictions on trade may continue for up to two years and result in lost sales ranging from millions to tens of billions of dollars. For example, after karnal bunt, a fungal disease of wheat, was discovered in north Texas in 2001, more than 25 countries banned wheat imports from four affected counties, resulting in a loss of revenue of about $250 million.[8]

The U.S. Department of Agriculture's Animal and Plant Health Inspection Service is tasked with keeping damaging invasive species out of the United States but cannot stop every threat. Pests and diseases do spread and very few can be successfully eradicated once they arrive. Instead, they must be managed and the damage they cause minimized.

Integrated Pest Management is the Long-Term Solution to Pest Challenges

There's no silver bullet or magic dust to control pests. The United States and world tried that approach in the years after World War II with broad-spectrum, persistent pesticides like DDT only to discover they caused significant environmental damage and their overuse quickly led pest species to develop resistance to the chemicals.

What works – and has been federal policy since 1977 – is an approach called integrated pest management, or IPM. IPM can be used in any setting where



Spray reductions in Arizona cotton since 1990. Source: Arizona Pest Management Center, University of Arizona.

unwanted pests occur but was developed for and is most important in agriculture. The National Roadmap for Integrated Pest Management outlines this federal approach and was most recently updated in 2018.[9]

Integrated pest management is a process and approach to managing pests, based on their biology and the ecology of the farming system or setting. It seeks to avoid pests and prevent pest populations from reaching economically damaging levels, and promotes natural, biological control of pest species when possible. Both organic and conventional growers use an array of IPM practices to control pests and reduce risks to the environment and human health.

IPM is often described as a continuum, following what's called the PAMS approach: Prevention, Avoidance, Monitoring and Suppression. The graphic has examples of tactics in each of these areas, but there are many, many others. The power of integrated pest management is that it's a process that's adaptable to any arena and any pest-management challenge.

Regional IPM Centers

Examples of IPM Tactics

Prevention: Keeping pests away from a field or area

- Using certified disease-free seeds or transplants
- Cleaning equiment between fields
- Netting, fencing and other exclusion activities

Avoidance: Keeping local pests from becoming a problem

- Chosing insect- or disease-resistant plant varieties
- Planting trap crops (or using phermone traps) to draw pests away from the main crop
- Rotating crops to prevent buildup of pest polulations

Monitoring: Knowing what pests and beneficials are around - and in what numbers

- Sweeping crops and accurately identifying insect populations
- Testing soils and monitoring weather
- Keeping records and tracking trends

Suppression: Reducing pest populations so they are not economically damaging

- Using cover crops and cultivation to manage weeds
- Encouraging or applying beneficial insects to control pest species
- Using selective, low-risk pesticides at the optimum time when economically necessary

For example, when an organic grower plants a vegetable variety they can harvest before weeds produce seed, it's IPM. It's IPM when a grower uses mating disruption to keep pests from multiplying, or sprays a selective insecticide that preserves the beneficial insects in their fields. It's IPM when plants are certified as disease-free before being imported or planted, and when growers clean their equipment before moving between fields.

Environmentally and economically, integrated pest management pays dividends. One of the most comprehensive long-term studies has been of the cotton industry in the Southwest, which showed growers were averaging 12 or 14 sprays each season in the early 1990s and they're making only two or three sprays per season now. By quantity, growers applied 4.15 pounds of active insecticide ingredient per acre of cotton in 1995, and that's down to 16 ounces per acre today. Pest-control costs also dropped, from a peak of $300 per acre to around $50.[10]

No one thing brought about those improvements. Instead, they were the cumulative result of many small improvements – new chemistries, new technologies, new scientific understanding of pest- and predator-insect relationships, and the education of growers about new IPM tactics.

That work is ongoing because the need is ongoing, in cotton and every cropping system. Conditions on the ground change as new pests are introduced or old pests resurge. Cropping systems and pest ranges

shift as a result of shifts in climate. Pests develop resistance to some pesticides, and others are taken off the market due to environmental or heath concerns.

Integrated pest management is the answer to America's pest challenges, but that answer is never fully finished. It is – and must always be – a work in progress.

Integrated Pest Management Infrastructure, Funding and the Regional IPM Centers

There is no single agency or authority governing IPM in the United States. There is a Federal IPM Coordinating Committee to plan and coordinate IPM use by federal agencies, as well as a National IPM Coordinating Committee that gathers input from states and regions to develop IPM research priorities and communicate those to federal officials.

The U.S. Department of Agriculture's National Institute of Food and Agriculture is the major funder of IPM research in the United States, supporting integrated pest management research through Specialty Crop Research Initiative grants, Agriculture and Food Research Initiative grants, support for the Sustainable Agriculture Research and Education program, and, most directly, through the Crop Protection and Pest Management program.

The three program areas in the Crop Protection and Pest Management program "support a wide spectrum of projects – from the discovery of IPM knowledge through research and development, to extension activities and implementation – all linked together through regional and national coordination, team-building and stakeholder engagement. Together the three program areas represent a comprehensive approach for developing IPM practices and strategies and implementing this new knowledge across many environments through a coordinated national network, producing positive outcomes for society by applying evidence-based science."[11]

The Crop Protection and Pest Management program funds three competitive grant programs. One provides research funds to develop new IPM tactics, technologies, practices and strategies; a second supports state IPM extension programs to deliver IPM information to growers and other pest managers; and the third funds coordination and communication through the Regional IPM Centers in the four regions of the country.

The Regional IPM Centers are on the front lines in the nation's never-ending battle with destructive pests. They engage farmers and extension agents and others on the ground who are first to notice changing pest pressures. They develop regional priorities and communicate those to federal agencies and land-grant universities, directing attention and funding to emerging problems. After the spotted lanternfly was detected in Pennsylvania, for instance, the Northeastern IPM Center funded a work group of regional researchers that have since received a Specialty Crop Research Initiative grant to investigate ways to manage this new destructive pest.

The Regional IPM Centers fund signature programs specific to their regions, and collaborate on national-level efforts to control invasive species and document IPM impacts. Each Center also provides grants to fund important IPM research and extension needs in their areas, and coordinates and communicates across state and regional borders to marshal resources and maximize efficiency.

This ongoing, collaborative science is critical to protecting American agriculture from current and future threats posed by native and invasive insect pests and pathogens.

Endnotes

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